ozonizating either aerated aqueous suspension withdrawn from the aeration tank or a part of the separated sludge, the ozonizating taking place at a pH of 5 or lower; and

recycling either the ozonized aerated aqueous suspension or the ozonized part of the separated sludge back to the aeration tank for aerobic biological treatment.

12. A process for aerobic biological treatment of an aqueous organic waste comprising the steps of:

introducing the aqueous organic waste into an aeration tank;

aerating the aqueous organic waste in the aeration tank in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension;

withdrawing aerated aqueous suspension from the aeration tank and introducing it into a membrane separation unit;

subjecting the aerated aqueous suspension in the membrane separation unit to membrane separation to form a permeated liquid and a concentrated sludge containing the biosludge;

withdrawing the permeated liquid from the process as treated water;

recycling at least a portion of the concentrated sludge back to the aeration tank;

ozonizating either aerated aqueous suspension withdrawn from the aeration tank or a part of the concentrated sludge, the ozonizating taking place at a pH of 5 or lower; and

recycling either the ozonized aerated aqueous suspension or the ozonized part of the concentrated sludge back to the aeration tank for aerobic biological treatment.

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REMARKS

The abstract and the specification have been extensively amended in order to correct grammatical and idiomatic errors contained therein. No new matter has been added.

In order to address the Examiner's rejections of the claims under 35 USC 112, and to more particularly point out and distinctly claim the subject matter the Applicants regard as the

invention, Claims 1 and 6 have been cancelled and replaced by newly presented Claims 11 and 12, and the remaining claims amended to reflect the replacement of Claims 1 and 6 by newly presented Claims 11 and 12. No new matter has been added. It is respectfully submitted that the currently presented claims are cured of all formal defects.

Claims 1, 2, 5 and 6 have been rejected under 35 USC 103 as being unpatentable over Dorau et al in view of Hei et al or Berndt or Kramer et al. Claim 3 has been rejected under 35 USC 103 as being unpatentable over Dorau et al in view of Hei et al or Berndt or Kramer et al and further in view of Brock. Claim 4 has been rejected under 35 USC 103 as being unpatentable over Dorau et al in view of Hei et al or Berndt or Kramer et al and further in view of Brock. Applicants respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

The presently claimed invention is directed to a process for the aerobic biological treatment of an aqueous organic waste. This process comprises the steps of introducing the aqueous organic waste into an aeration tank, aerating the aqueous organic waste in the aeration tank in the presence of a biosludge composed essentially of aerobic microorganisms to form an aerated aqueous suspension, withdrawing the aerated aqueous suspension from the aeration tank and introducing it into a solid/liquid separation unit, subjecting the aerated aqueous suspension in the solid/liquid separation unit to solid/liquid separation to form a separated sludge containing the biosludge and a separated liquid phase, withdrawing the separated liquid phase from the process as treated water, recycling at least a portion of the separated sludge back to the aeration tank, ozonizating either aerated aqueous suspension withdrawn from the aeration tank or a part of the separated sludge, the ozonizating taking place at a pH of 5 or lower, and recycling either the ozonized aerated aqueous suspension or the ozonized part of the separated sludge back to the aeration tank for aerobic biological treatment. In a

preferred embodiment of present invention, the solid/liquid separation unit is a membrane separation unit.

It is known to treat organic waste through the use of aerobic biological treatment. Conventional processes have a problem in that a large amount of "excess sludge" is formed by these processes and must be either burned or disposed in a landfill. The present invention is based on the discovery that the reduction of the amount of excess sludge generated can be accomplished by using ozone to oxidatively reduce waste materials containing biosludge and recycling the oxidized waste material back into an aerator. It is respectfully submitted that the prior art cited by the Examiner does not disclose such a process.

The Dorau et al reference is directed to a method and apparatus for biologically purifying sewage in which the sewage is aerated in a bioreactor 3, a portion of the aerated sewage introduced into a membrane ultrafilter 9, the filtrate 11 sent to a filtrate basin and the sludge from the membrane ultrafilter recycled back to the bioreactor or removed as excess sludge 13. The filtrate from the filtrate basin 15/1 is then sent to a reactor basin where it can be treated with ozone.

The presently claimed invention is distinguishable over the Dorau et al reference in that the present invention utilizes ozone-treatment of biosludge, including the excess sludge 13 of Dorau et al, and returns at least a part of it back to the bioreactor. This type of treatment is not shown in Dorau. Although the excess sludge 13 of Dorau is not further subjected to biodegradation due to its biologically stable nature when returned to the bioreactor 3, the present invention makes the excess sludge susceptible to further biodegradation by subjecting it to an ozone treatment which allows a reduction in the amount thereof.

The complete elimination of excess sludge can only be realized by the ozone-treating of a part of the biosludge returned from the return line in addition to the excess sludge 13 or the aerated aqueous suspension removed from the bioreactor. This is not suggested in Dorau. Moreover, the present invention requires that the ozone-treatment be performed at a pH of 5 or lower in

order to achieve the superior results associated with the present invention. The secondary references cited by the Examiner must provide the motivation to one of ordinary skill in the art to modify the Dorau et al process in a manner that would yield the presently claimed invention. It is respectfully submitted that the prior art cited by the Examiner contains no such disclosure.

The Hei et al reference discloses the use of a potentiated aqueous ozone cleaning composition for the removal of the contaminating soil from a surface. Evidently, this reference has been cited by the Examiner for its disclosure at Column 3, lines 38-53 regarding the solubility and instability of ozone at various pHs. However, the fact that ozone may become more unstable at higher pHs has no correlation at all with respect to the reaction efficiency of ozone at the presently claimed pH range. Likewise, with the Berndt and Kramer references cited by the Examiner which also speak to the stability of ozone at various pH levels, there is no teaching contained in these references which would lead one of ordinary skill in the art to conduct ozonization of a biosludge and a pH of 5 or lower. Therefore, Applicants respectfully submit that only hindsight provided by Applicants' disclosure is providing the motivation for the Examiner to argue the claimed combinations.

Although the Brock reference does have a general disclosure with respect to microbes, there is no teaching in this reference which suggests that microbes could be used with the ozonization treatment of biosludge. Moreover, since the primary Dorau reference differs fundamentally from the present invention and that it teaches the ozone treatment of filtrate through a membrane but not of a biosludge as required in the present invention, the combination of the references cited by the Examiner would not teach one of ordinary skill in the art to treat biosludge at a pH of 5 or lower.

Comparative Example 2 on page 55 and 56 performs the ozone treatment at pH 7. As shown by the results of this Example, the rate of the formation of the excess sludge was the same as if the ozone treatment was omitted. Likewise, with Comparative Example 6

in which the pH was 7 during the ozone treatment. Although the references cited by the Examiner do not present a showing of *primae facie* obviousness, the test data contained in the present application clearly show the unobviousness of Applicants' performing the ozone treatment of the sludge at a pH of 5 or lower. Therefore, the patentability of the presently claimed invention has clearly been established. As requested by the Examiner, an English abstracts of the JP Kokai is enclosed herewith. Reconsideration of the present application and the passing of it to issue is respectfully solicited.

Respectfully submitted,

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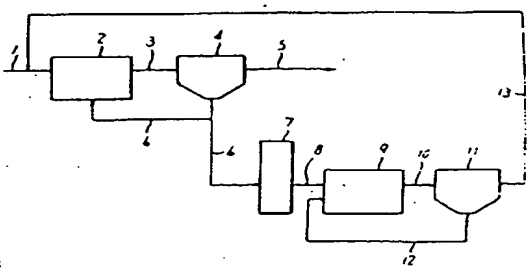
Encl: English Abstracts of JP55-8835, JP59-105897, JP59-11289 and JP2-222798
Postal Card

136.8905

(54) TREATMENT OF SURPLUS SLUDGE
(11) 55-8835 (A) (43) 22.1.1980 (19) JP
(21) Appl. No. 53-81301 (22) 4.7.1978
(71) SHINRIYOU REINETSU KOUGIYOU K.K. (72) AKIRA SUZUKI(1)
(51) Int. Cl³. C02F11/02

PURPOSE: For efficiently and cheaply treating surplus sludge to minimize disposed amount, the surplus sludge is treated physically or chemically to destroy their microbe cells for nutrient.

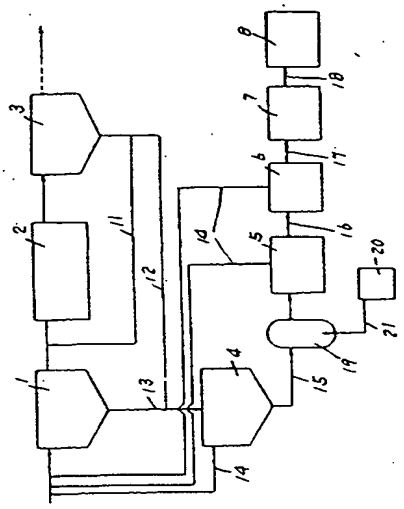
CONSTITUTION: Returned sludge is partly taken as surplus sludge and introduced into the decomposition bath 7 through line 6. In the bath 7, physical means such as ultrasonic wave and mixer, or chemical means such as ozone gas is used to destroy microbe cells constituting suspension in the surplus sludge. This transforms the surplus sludge into organic solvent, which is sent through line 8 to the aerobic digestion bath 9. In this bath 9, the organic solvent and active sludge is mixed while being exposed to air, thereby to cause the active sludge to take the solvent in as nutrient. The process is cheap, efficient and simple to operate, reducing the disposed sludge.



(54) DIGESTION OF SLUDGE
(11) 59-105897 (A) (43) 19.6.1984 (19) JP
(21) Appl. No. 57-214234 (22) 7.12.1982
(71) MITSUBISHI JUKOGYO K.K. (72) YUUJI YASUDA
(51) Int. Cl³. C02F11/04

PURPOSE: To remarkably improve the performance of treatment, e.g. a digestion velocity and the efficiency of decomposing organic substance in a digestion tank, by ozonizing sludge formed from biotreatment of waste water as a pretreatment, and then digesting it.

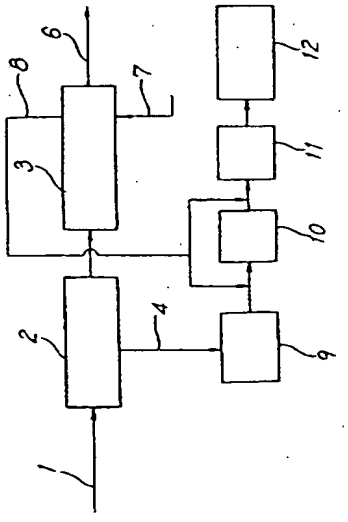
CONSTITUTION: Conc. sludge 15 from a thickener tank 4 and ozonized air 21 formed by an ozonizer 20 are supplied to an ozone oxidation tank 19. In the tank 19, the cell membrances of microbe mass in the conc. sludge are destructed by the action of the ozonized air to annihilate microbes. The sludge treated in the ozone oxidation tank 19 is introduced into a digestion tank 5 and corrupted therein using methane bacteria to decompose organic substance. Hence, the volume of the sludge is further reduced in its volume. By adopting the ozonizing treatment having the function to destruct the cell membranes as a pretreatment in this way, the performance of treatment, e.g. a digestion velocity and the efficiency of decomposing organic substance in the digestion tank, can be remarkably improved.



(54) TREATMENT OF WASTE OZONE IN WASTE WATER DISPOSAL
(11) 59-112899 (A) (43) 29.6.1984 (19) JP
(21) Appl. No. 57-222927 (22) 21.12.1982
(71) MITSUBISHI JUKOGYO K.K. (72) YUUJI YASUDA
(51) Int. Cl³. C02F11/04,C02F11/12

PURPOSE: To make a process compact as a whole, by using unreacted waste ozone discharged from the step of advanced treatment for the pretreatment of dehydration and/or anaerobic digestion in a sludge disposal step.

CONSTITUTION: Biodecomposable organic substance, etc. are removed from raw water 1 in a biotreatment step 2 such as an activated sludge process, and a treated liquid is sent to the step 3 of advanced treatment to remove difficultly biodecomposable substance such as fine SS and drained as treated water 6. Excess sludge 4 is treated in the step 5 of sludge disposal. Waste ozone 8 discharged from the step 3 of advanced treatment is applied to the pretreatment of a dehydration step 11 or a digestion step 10 for sludge disposal. As a result, internal water in cells is changed into a state extremely easy to be excluded, and the efficiency of decomposition by anaerobic digesting bacteria is improved to promote the reduction of sludge. Consequently, the digestion step 10, the dehydration step 11 and a drying-burning step 12 are all remarkably made compact.



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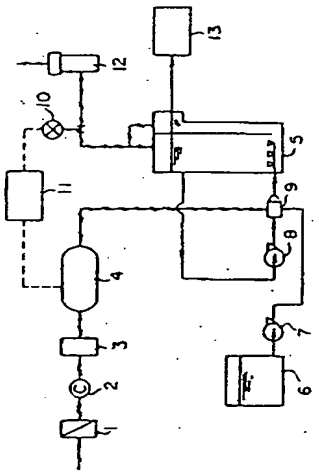
(54) PRETREATMENT OF SLUDGE
(11) 2-222798 (A) (43) 5.9.1990 (19) JP
(21) Appl. No. 64-44672 (22) 23.2.1989
(71) SUMITOMO HEAVY IND LTD (72) KENJI YAMAMURA
(51) Int. Cl⁵. C02F11/04

PURPOSE: To increase the efficiency of digestion of excess sludge from a sewage treating process by decomposing the sludge by oxidation with ozone.

CONSTITUTION: Air is sent to an ozonizer 4 through a compressor 2 and a moisture remover 3. Ozone generated in the ozonizer 4 is sent to an ejector 9. Excess sludge accumulated in a storage tank 6 is fed into the ejector 9 by a sludge feeding pump 7 and introduced into an ozone reaction vessel 5 together with the sent ozone. In the vessel 5, the sludge is brought into contact with the ozone, decomposed by oxidation, subjected to vapor-liq. separation and sent to a post-treating process 13 such as an anaerobic digesting process. Gas obtd. by the separation is fed into an apparatus 12 for treating waste ozone, the residual ozone is treated and the gas is discharged into the air. Thus, secondary pollution is prevented.




(54) AEROBIC TREATMENT OF ORGANIC WASTE LIQUID
(11) 6-206088 (A) (43) 26.7.1994 (19) JP
(21) Appl. No. 5-2716 (22) 11.1.1993
(71) KURITA WATER IND LTD (72) HIDENARI YASUI
(51) Int. Cl⁵. C02F3/12

PURPOSE: To obtain a method for aerobic treatment of organic waste liq. wherein the formation of an excessive sludge is reduced, even to zero, without lowering load and treating efficiency.

CONSTITUTION: In the method for aerobic treatment of organic waste liq. in the presence of the activated sludge contg. aerobic microorganisms, sludge 3f is removed from an aerobic treating system 1 in a larger amt. than the sludge 3d growing by BOD assimilation in the liq. 4 to be treated, treated with ozone in an ozonizing system 2 and sent back into the aerobic treating system 1.